

Report for Contract Nonr-3579(04)
for the period 1 June through 31 August 1966
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Status of Proposed Problems

- A. Vigilance Studies
(C. S. Watson and T. L. Nichols)

FACILITY FORM 902

N66-87152
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Work on this problem has been completed and the results are being prepared for publication.

- B. Method of Free Response
(C. S. Watson and T. L. Nichols)

Work on this problem has been completed. A paper describing the experiment was presented at the June, 1966, meeting of the Acoustical Society of America. The results are being prepared for publication as a DRL Acoustical Report. A condensed version is being prepared for publication.

- C. Detection Performance and Two Parameters of the Auditory Stimulus
(T. L. Nichols)

Work on this problem has been completed and the results were used as the basis for a doctoral dissertation. Two articles covering the work are being prepared for publication and a paper covering part of the work will be presented at the November, 1966, meeting of the Acoustical Society of America. An abstract of the dissertation is included in the appendix.

- D. Effects of Chromatic Adaptation on Color Naming
(G. H. Jacobs)

Work on this problem has been completed and the results are being prepared for publication. The problem is being extended to include the effect of chromatic adaptation on the saturation of colors, again employing the color-naming procedure.

E. Signal Detection and the Width of Critical Bands
(R. B. Evans and L. A. Jeffress)

Work on this project is continuing. Since the number of filters required, and therefore the quantity of data, is considerable, the work is progressing slowly but should be completed during the present grant period.

F. Psychometric Functions for an Ear Model: Effect of Duration
(L. A. Jeffress and A. D. Gaston, Jr.)

Work on this problem has been completed. The results are being published in the Journal of the Acoustical Society of America for December, 1966. An abstract of the article is included in the appendix and 25 copies of the manuscript have been sent to the National Aeronautics and Space Administration Office of Grants and Research Contracts and to other NASA agencies.

APPENDIX

DETECTION PERFORMANCE AND TWO PARAMETERS OF THE AUDITORY STIMULUS

Thomas Lawrence Nichols

Abstract

Four subjects were run in a conventional yes-no psychophysical experiment in auditory masking. The stimulus consisted of a 250 msec burst of band limited white noise. On 50% of the trials, a 500 Hz sinusoidal signal was added to the noise burst. On each trial, a record was made of the nature of the stimulus (i.e., either signal-plus-noise, or noise alone), the subject's response latency, the nature of his response (i.e., "yes", or "no"), and two physical measures of the stimulus waveform. The two physical measurements were made using an electronic ear model consisting of a narrow band filter (simulating the subject's critical band) followed by a rectifier and two measurement devices. One of these devices measured the magnitude of the largest peak voltage occurring during the stimulus interval, and the other measured the average voltage of the stimulus envelope.

A series of multiple linear regression models were constructed to determine the independent contribution of each of these electrical measurements to prediction of the nature of the stimulus event, and the nature of the subject's response. The average energy of the stimulus envelope was found to be the more efficient predictor of both of these criteria, and also the more important in determining the subject's response. The maximum peak amplitude was a poor predictor of both criteria, and added little predictive efficiency of a model which already contained the average energy predictor. The Theory of Signal Detectability states that an observer uses a large number of stimulus dimensions in reaching a decision about the nature of the source of a stimulus. This research indicates that the average energy of the input is a dimension of great

importance in the decision process and that the maximum peak value is a relevant, but far less important, dimension.

Response distributions were constructed by plotting all "yes" and all "no" responses separately against the value of the average stimulus energy associated with each response. The index of detectability, d' , computed from these distributions was in good agreement with the d' values computed from the conventional theoretical distributions of TSD.

The probability of a "yes" response, the probability of a correct response, and the response latency of all responses were also plotted as a function of stimulus level (expressed as average energy level). The probability of a "yes" response was found to increase with the average energy of the stimulus (even though the overall signal to noise ratio, E/N_0 , was constant), and the probability of a correct response was found to be highest for low and high values of the average energy. Response latency was greatest for middle values of average energy.

These results indicate that gradations in stimulus level, whether a signal is present or not, produce gradations in response probability and latency in a continuous fashion. These results are in opposition to classical threshold theory, and support the formulations of the Theory of Signal Detectability.

STIMULUS-ORIENTED APPROACH TO DETECTION RE-EXAMINED

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Abstract

The present paper is a re-examination of some of the conclusions of an earlier one. It is motivated by some new insights resulting from attempts to replicate experiments with human observers through the use of an electrical model of the auditory system. It is concerned primarily with the effect of signal duration on detection in the presence of a continuous masking noise. The model, of those tried, that best fits human performance consisted of a bandpass filter obtained by subtracting the output of a 500 Hz sharp-cutoff, low-pass filter from another having a cutoff of 525 Hz. The filter was followed by a linear half-wave rectifier, and it in turn by an integrator having a 100 msec decay time. The integrator can be thought of as a device which takes a running average of its input.

The probability density distributions for N and SN yielded by the model lie between the Rayleigh-Rice distributions on the one hand and a pair of normal distributions of unequal variance on the other. The exact shape of the two distributions depends upon both the bandwidth of the filter employed and the time constant of the averager.

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